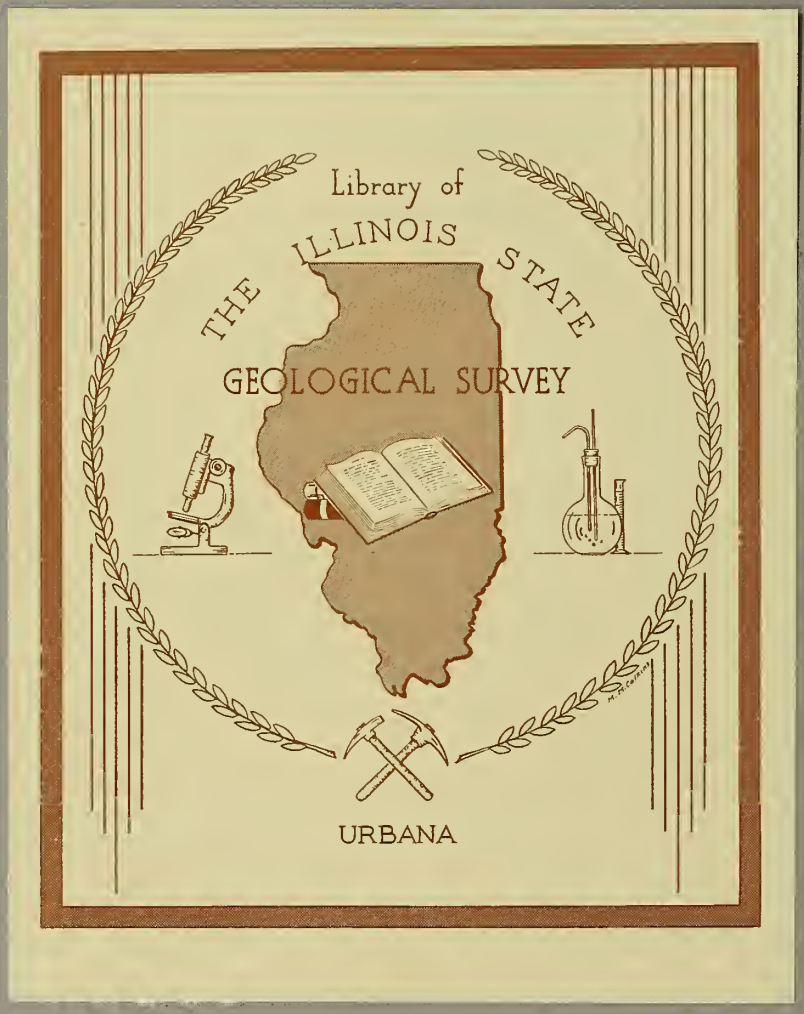

State of Illinois
Henry Horner, Governor
Department of Registration and Education
Division of the
STATE GEOLOGICAL SURVEY
M. M. Leighton, Chief
Urbana

INFORMATION CIRCULAR NO. 12

ABSTRACTS OF PAPERS DEALING WITH ROCK AND ROCK PRODUCTS

Presented at the
THIRD ANNUAL MINERAL INDUSTRIES CONFERENCE
OF ILLINOIS
May 17-18, 1935

August, 1935

INTRODUCTORY NOTE

The Third Annual Mineral Industries Conference, sponsored by the Illinois State Geological Survey of the Department of Registration and Education, and the Engineering Experiment Station of the University of Illinois, in cooperation with 25 interested organizations, was held in Urbana, May 17 and 18, 1935. The keynote of the conference was "Trends in the utilization of mineral products." The following abstracts of papers have been prepared in order that members of the rock and rock products industry who were unable to attend the conference may be acquainted with the information presented at the conference bearing on their industry. Publication of papers in full is planned at a later date. The Survey does not assume responsibility for the statements here presented.

GENERAL SESSION

Addressing the General Session on the subject, "Illinois' Position as the Keystone Mineral State of the Upper Mississippi Valley," Dr. M. M. Leighton, Chief of the Illinois State Geological Survey, stated that for many years Illinois has been the leading mineral producing state of the Upper Mississippi Valley. Will it continue this leadership on a scale which will be reasonably profitable to investors? Illinois' nonmetallic resources are enormous and diverse including a variety of clays and shales for clay products, limestone and shale for cement manufacture, stone for exterior and interior construction, sand, gravel, and crushed stone for concrete aggregate and surfacing for farm-to-market roads, glass sand, and woolrock for making of insulating materials. The processing minerals include limestone and dolomite of many varieties, silica sand, tripoli, fluorspar, fuller's earth, and other types of clays and sands not already mentioned. Although largely lacking in metalliferous deposits, many of these are readily at hand in other states of the Upper Mississippi Valley.

The answer to the question appears to be that although there are adverse factors which seriously threaten the position of Illinois as a leading mineral producing State in the Upper Mississippi Valley, the light of science is dawning on the horizon for the mineral industries of the State and her transformations are likely to be as beneficial and as sweeping as they have been for other industries of our complex civilization. The mineral industry, therefore, should keep in close contact with science in order to take full advantage of its findings, intelligently and profitably, for the sake of the future of the industry. To do this the man with large investments in mineral industries must either take time to school himself in science or be associated with a man so trained.

Exemplifying the type of benefits industry may expect from science may be cited the researches now in progress by the Illinois State Geological Survey on the constitution of clays and shales which promise to be of much significance to

the clay and clay products industry in lighting the way to improvement of existing products and finding new products. Similarly promising results may be anticipated from researches under way in the fields of the rock and rock products, fluorspar, and silica industries. Recently the Survey has discovered large deposits of woolrock in Illinois, close to transportation and markets, and suitable for the manufacture of high grade rock wool for the insulating industry.

A paper, "Technologic Trends in the Production and Utilization of Rock and Rock Products," by Mr. N. C. Rockwood, President, Rock Products, Chicago, indicated a present trend in quarrying of consolidated rocks towards the use of more flexible equipment and safer high explosives, and in the case of unconsolidated rock deposits, such as sand and gravel, towards a constant perfection of standard pieces of equipment. In the sand and gravel industry of the mid-west, a pronounced trend is toward smaller, movable plants.

Many developments are to be noted in the equipment used for preparing rock materials for use. Improvements have been made in crushers, particularly reduction crushers. Roll type crushers are increasing in popularity for the production of small sized aggregates for surfacing of various types of highways. The use of vibrating screens for the preparation of many of the finer sized aggregates is now almost universal. Most recent additions to the processing of aggregates are various types of hydraulic classifiers.

Trends in utilization of rock products involve an increased use of aggregates, including both crushed stone and crushed gravel, for the construction of secondary highways and for resurfacing of older paved highways, a more extensive use of washed and classified fine fragments of rock as stone sand, and closer control of molding sand bonds with special attention to bonding clays for use with washed sand.

In the field of chemically prepared rock products, the lime industry is giving more attention to details of burning and cooling processes, recognizing that quality is more under their control than they formerly believed. The possibility that the future may witness the production of the metals calcium and magnesium from lime, limestone, or dolomite was suggested. Trends in the manufacture of Portland cement are distinctly toward truer chemical control. Recent application of oil flotation of raw cement rock, to increase the calcium carbonate content, points the way to a better control of the raw mix, to making special cements, and to a really standard Portland cement.

The most important market trends, which affect the business of the aggregate producer, have been induced by the attitude of government officials which has tended to overlook the great investment in commercial plants and the years of experience of commercial producers in perfecting their operations and products and to turn to new local production of untried and unproved quality, using relief labor in most instances.

The "Viewpoint of Science Regarding the Production and Utilization of Nonmetallic Minerals" was discussed by Professor C. W. Parmelee, Head, Department of Ceramic Engineering, University of Illinois, and J. E. Lamar, Head of the Non-fuels Division, Illinois State Geological Survey, who believe that the future will witness the continuance of many of the existing uses for nonmetallic minerals in their raw state and as manufactured products together with a continuous development of new products and uses, with increasing emphasis on the production of raw materials or products having definite physical, chemical and mineralogical characteristics, and a gradual tightening of specifications. Looking ahead, science definitely stands on the premise that chance will not be the major governing factor in the development of the nonmetallics industry, although it may play a part, but rather that science has a specific assignment, namely, to anticipate new needs or meet existing needs for nonmetallic mineral products on the basis of controlled and directed studies of possible combinations and modifications of the basic nonmetallic mineral resources of Illinois and of methods by which such combinations and modifications can be effected.

Professor Donald B. Keyes, Head of Chemical Engineering Division, University of Illinois, discussing the topic, "The Viewpoint of Science Regarding Chemical Engineering Problems Relating to the Mineral Resources of the State," called attention, in the nonmetallic field, to the development of synthetic stone and the possibility that further work in this field may mean the production of a superior type of stone. Silica aerogel recently developed in the laboratories of the Chemical Engineering Division of the University of Illinois is said to be one of the finest heat insulators ever produced and can be made from the mineral resources of Illinois. This product should be thoroughly studied in order to determine its practical feasibility.

EXHIBITS AND DEMONSTRATIONS

Blowing of Rock Wool from Illinois Rock, Charles F. Fryling, Chemist, State Geological Survey. Following the general session an opportunity to witness the blowing of rock wool was afforded in one of the laboratories where impure limestone was transformed into a white, fibrous, wool-like material. The process is as follows:- Crushed rock of suitable chemical composition, widely prevalent in Illinois, is melted to a fluid glass in a small induction furnace. The furnace is then tilted to allow the white-hot liquid to pour in a steady stream into a high pressure steam blast issuing from a "steam gun" held at a right angle to the flow of glass. The melting of the steam and the molten material effects the transformation of the latter into wool. A bombardment proceeds from the point of meeting, consisting of thousands of minute, white-hot particles being propelled through the air at a high velocity, dragging out hair-like threads of glass in their wake. Toward the far end of the chamber, at a distance of about twenty to thirty feet from the blowing nozzle, masses of wool settle to the floor.

Rock wool has properties which stamp it as an ideal heat and sound insulation material, the market for which is growing at a rapid rate. Mineral operators of Illinois would do well to investigate in further detail factors relative to the rock wool industry. It has been fully demonstrated that the physical "set-up" is exceedingly favorable to the industry in our State. For those parties who are sufficiently interested in the development to investigate further, a thorough perusal of the State Geological Survey's Bulletin No. 61, "Rock Wool from Illinois Mineral Resources," is recommended.

Exhibit of Novaculite Refractories, C. W. Parmelee, Head of the Department of Ceramic Engineering, University of Illinois. The exhibit of the researches on the use of Southern Illinois novaculite included a large number of small fired specimens which had been prepared with the use of various bonding agents and accelerators. An important phase of the study of this problem had been the proper sizing of the crushed material. These specimens demonstrated that with a proper sizing of grain and choice of the bonding agent, excellent results could be obtained since the appearance and the compressive strength equalled that of commercial silica brick. A few specimens of standard size novaculite brick prepared in a similar manner were exhibited.

EVENING ADDRESS

One of the high points of the meetings was the address by Dr. John W. Finch, Director of the U. S. Bureau of Mines, which followed the annual Conference dinner. Dr. Finch pointed out that minerals are more necessary to the life and well-being of people than most persons realize. Not only are minerals necessary for progress and for comfortable human existence, but mining carries a large burden of responsibility for the welfare of the community. He said that the chief cause of trouble in the mineral industry today, over-production and unemployment, have their seeds in the World War and not in the depression. The period of inflation and over-production following the war necessitated a period of readjustment that has not yet been accomplished. According to Dr. Finch, the committee appointed by the President to study causes of maladjustment and unemployment in the industry and to recommend means of improvement had recommended that the government allow the various groups in the industry to attempt to work out their own affairs, and that all other expedients would be tried before that of government control.

SYMPOSIUM ON ROCK AND ROCK PRODUCTS

On Saturday morning, May 18, a symposium of seven timely papers on rock and rock products was presented before an audience including representatives of the various nonmetallic industries of the State.

Little known building stone resources of Illinois were described in a paper entitled "The Building Stone Possibilities of Illinois Limestones," by J. E. Lamar, Geologist and Head, Non-fuels Division, Illinois State Geological Survey. This paper, based on a preliminary study made by the Illinois Geological Survey, pointed out the presence of deposits containing beds more than three feet thick of pink, gray-white, cloudy gray, buff, mottled gray, gray oolitic, dark gray almost black, and breccia marbles suited to interior use. The deposits occur in the north, west and south parts of Illinois. Gray travertine occurs as a part of the Niagaran formation in the Chicago area and also in the LaSalle limestone of the LaSalle region. Buff travertine is available from dolomite formations in northwestern Illinois. Stone for exterior construction purposes is to be had at many places in north, west and southern Illinois and includes a variety of grays, buffs, and browns and in southern Illinois also oolitic limestone resembling the well known Bedford stone.

The popularity of mineral wool insulation indicates future expansion of the industry, according to Charles F. Fryling, Chemist, Illinois State Geological Survey, and Orval White, President, Mineral Insulation Company, Chicago Ridge, in a paper entitled "Factors in the Development of a Rock Wool Industry." Factors, of importance in establishing a plant, are: (a) There are about 30 plants, 8 in Indiana, the remainder scattered from Vermont to California; (b) freight rates are high, ranging from $0.70 to $50.00 per ton depending on distance; (c) woolrock deposits are widespread, some have recently been found in Illinois, southern Indiana, and Ontario; (d) patents on blowing insulation into dwellings are held jointly by six companies; (e) an estimated cost of a two-cupola plant, exclusive of land and quarry equipment, is $38,000; (f) it should be possible to produce rock wool at $20.00 per ton. The present trend seems to be toward decentralization in order to supply local needs more economically. The beginnings of the rock wool industry in Indiana, together with present plant practice, were described. Suggestions based on similarities in the manufacture of rock wool and Portland cement were advanced for overcoming production difficulties at present encountered. Semi-plant scale development work is advocated.

Mr. W. H. Coghill, Supervising Engineer, Mississippi Valley Station, U. S. Bureau of Mines, Rolla, Missouri, presented a paper, "Concentration of Nonmetallics by Tabling of Agglomerated Materials," which drew attention to the fact that methods of ore dressing generally considered applicable only to metallic ores have been shown in recent years to be important in the beneficiation of many nonmetallic products. The use of concentrating tables, agglomeration, and flotation have all been shown to have special application in separating constituents not readily separable by the conventional methods of washing and screening. Where the constituents have sufficiently different specific gravities, shapes, or sizes, separation can be made on concentrating tables as shown recently at a gravel plant where a notable quantity of coal is removed from river gravel by tabling. Certain nonmetallic ores are suitable for separation by selective oiling or agglomeration. By this method two minerals, which may have about the same specific gravity are subjected to crude oil and one of several organic reagents such as fatty acids or fatty acid soaps, which form a film on one of the minerals. The mineral coated is easily floated and separated by tabling. This method is now used in improving the grade of phosphate ore concentrates and has been shown to be applicable to the separation of certain ores composed of KCl and NaCl. It is thought that the field of nonmetallics is a fertile one for application of these methods.

"The Significance of Accelerated Soundness Tests on Stone and Gravel" was the title of a paper presented by Mr. A. T. Goldbeck, Director, Bureau of Engineering, National Crushed Stone Association, Washington, D. C., who pointed out that in considering the materials for use in any structure the durability of those materials for the component parts of the structure with their different exposure conditions should be considered just as carefully as the stress-resisting properties of those materials. Although unsound aggregates are known to be a possible source of trouble in concrete, the durability of concrete is mostly determined by the durability of the mortar, and most lack of durability can be traced to the presence of too much water in the concrete before it has hardened. However, aggregates do cause trouble, and in recognition of this fact accelerated methods for detecting unsound aggregates have been devised. The tests commonly employed are the sodium sulfate or magnesium sulfate soundness tests and the freezing and thawing tests. A critical examination of these tests would seem to lead to the following conclusions:

(1) That the results obtained in the sodium sulfate soundness test may vary because of the use of the same sieve for preparing the sample as for measuring the per cent of loss and because of slight variations in the temperature of the solution or to other unexplained variations in the method.

(2) The freezing and thawing accelerated soundness tests will give different percentages of loss for a given number of cycles, depending entirely upon the rate at which freezing takes place.

The results obtained with the sodium sulfate test and the freezing and thawing test are only in fair agreement with one another and there have been some notable examples of lack of agreement. An accelerated soundness test does not with certainty determine the soundness of an aggregate unless it is known that the results of that test agree with service behavior. Failure in an accelerated soundness test should be taken as a danger signal, but final judgment of an aggregate should be based on the performance of the aggregate in actual use.

Professor D. R. Mitchell, Assistant Professor of Mining and Metallurgical Engineering, University of Illinois, reviewed a paper by Professor Benjamin L. Miller, Professor of Geology, Lehigh University, and C. H. Breerwood, Vice-President and General Manager, Valley Forge Cement Company, published as Technical Publication No. 606, American Institute of Mining and Metallurgical Engineers, entitled "Flotation Processing of Limestone." This report describes the use of froth flotation for correcting the composition of limestones poorly adapted for cement because of low lime content or improper ratios of silica, alumina, or iron and suggests the possibility that by proper processing of the same type of rock, suitable material can be produced not only for ordinary Portland cement but for practically all kinds of special cements with only minor amounts of foreign material, if any, for special correction. Advantages of limestone processing listed are: quarrying costs are reduced, limestone hitherto unavailable becomes usable, costs of grinding raw rock are reduced, coal is saved, costs of clinker grinding are reduced, available supplies of limestone are increased, purchase of high-grade limestone is eliminated, quality of cement is improved, a company is enabled to produce different products and there is the possibility of marketing materials separated from the limestone. Disadvantages of processing include cost of plant, cost of operation and value of stone discarded.

A "Preliminary Report of Tests on Small Specimens of Silica Refractories from Novaculite," by Professor C. W. Parmelee, Head of the Department of Ceramic Engineering, University of Illinois, mentioned the existence in extreme southern Illinois of large deposits of novaculite, a form of silica which has found only a limited use for the manufacture of silica refractories. The present investigation to determine the little known properties which affect its use for silica refractories is incomplete but the following conclusions may be drawn on the basis of the work to date: (1) Novaculite

inverts to cristobalite more rapidly than does quartzite, the inversion is more complete and takes place at much lower temperatures; (2) novaculite must be inverted very slowly at a low temperature to prevent shattering of the grains; (3) in the presence of certain fluxes the inversion of novaculite to cristobalite has been observed to proceed at a reasonable speed below 1000°C.; (4) proper grading of grains is of prime importance both from the standpoint of manufacture and use and novaculite has been found to crush easily to the proper grade; (5) trial specimens have been made which have the same compressive strength as commercial silica brick.

A paper, "Trends in the Utilization of Lime and Lime Products," by Lee S. Trainor, Chief Engineer, National Lime Association, Washington, D. C., stated that lime is sold for a wide variety of uses in three distinct fields - chemical and industrial processes, agriculture, and construction. Probably the most important trend in the chemical and industrial use of lime is to be found in new and improved methods of treatment of municipal and industrial water supplies and in the treatment and purification of domestic and industrial wastes.

Some of the more important agricultural uses of lime include soil treatment, in dusts and sprays and in rations for stock. Recent additions to our knowledge of soil correction problems makes possible a more intelligent use of liming materials and it is now possible to quickly measure the acidity of a soil and to prescribe the approximate quantity of liming materials needed to give the desired condition for optimum growth of different crops.

The use of lime for construction purposes dates back to the earliest records of civilized man, and lime was the principal bonding agent in masonry mortar until the recent adoption of Portland cement. This change was made on the assumption that increased mortar strength guaranteed higher strength in masonry and was accompanied by widespread dissatisfaction due to an ever increasing number of leaky masonry walls. Recognizing the importance of this situation, extensive research projects were initiated by several organizations. The results of these studies demonstrate that to bond uniformly, completely and permanently to different types of building units, under a diversity of conditions a mortar must be adaptable - that is, it must produce a good extent of bond with all types of building units without the necessity of wetting them before laying. The studies indicate that for all normal masonry above grade, the proper combination of properties is obtained in a mortar composed of two volumes of lime, one volume of Portland cement and approximately nine volumes of sand.

Abstracts of the papers dealing with Coal and with Clay and Clay Products may be obtained by addressing the Chief, Illinois State Geological Survey, Urbana.